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United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist and Chief of Bureau.

THE HARLEQUIN CABBAGE BUG.

(*Murgantia histrionica* Hahn.)

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INTRODUCTORY.

A moderate-sized red and black plant-bug, variously known as "calico back," "fire bug," and "terrapin bug," as well as harlequin

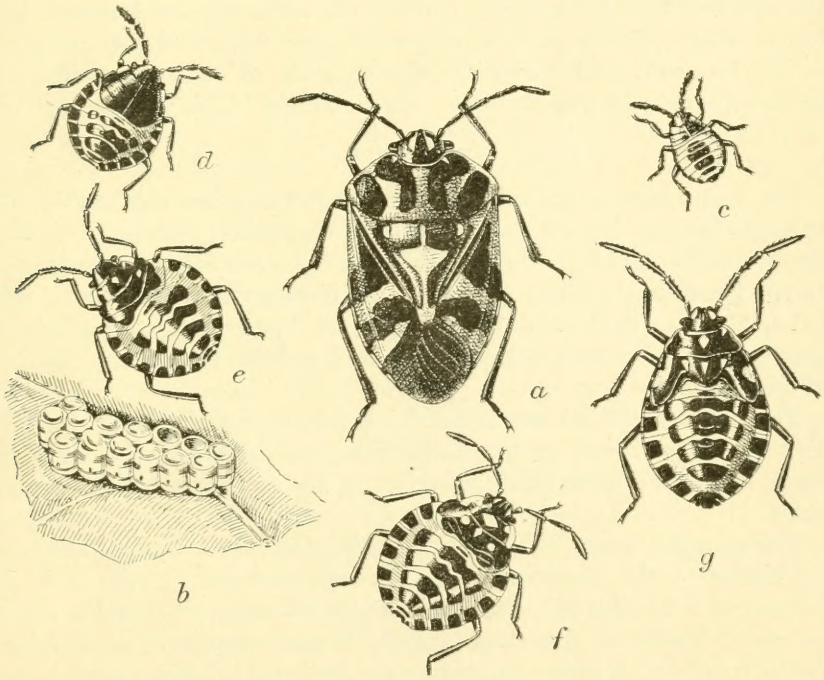

FIG. 1.—Harlequin cabbage bug (*Murgantia histrionica*): *a*, Adult; *b*, egg mass; *c*, first stage of nymph; *d*, second stage; *e*, third stage; *f*, fourth stage; *g*, fifth stage. All enlarged (original).

cabbage bug, is the most destructive insect enemy of cabbage and related crops in the southern part of the United States. At one time it was a serious pest northward to New Jersey and westward to Ohio

and, indeed, threatened to invade New York and New England. In recent years, however, its progress in the northern States has been checked by atmospheric conditions.

This plant-bug accomplishes its work of destruction by sucking the sap from leaves and veins of cabbage and other crucifers, the affected plants wilting, withering, and dying as if they had been swept by fire, whence the name "fire bug." It is a pest which, if permitted to propagate unmolested in seasons which favor its increase, is certain to destroy a portion if not all of the fields which it infests. A half dozen mature insects are capable of destroying a small plant in one or two days. Some years ago, when this species was abundant in the vicinity of the District of Columbia, the writer saw many large fields in Maryland and Virginia from which not a single good cabbage could be picked, and observed similar injury to horse-radish and some other crucifers.

The harlequin bug has been compared to the boll weevil as a pest in the South and to the San Jose scale as a scourge in New Jersey. Certainly it is to the cabbage grower what the other two insects are to the cotton planter and fruit raiser respectively. If growers generally, however, will undertake the methods of control, as advised in this circular, there is no reason why it should be longer destructive.

DESCRIPTIVE.

The name harlequin cabbage bug scarcely requires explanation to any one familar with the appearance of the insect. Its gay red and black ornamentation is suggestive of the dress of the stage harlequin. In the figure of the adult (fig. 1, *a*) the dark portions illustrated are either black or dark metallic blue and the light portions are bright yellow in freshly transformed bugs and red in fully hardened individuals.

The eggs (fig. 1, *b*) are beautiful objects and remarkable for the fact that they closely imitate in miniature white barrels bound with black hoops and with black spots set in the proper place for bung-holes.

The younger stages, or nymphs, of this species bear considerable resemblance to the mature form, differing, however, in the lack of wings and in having only four joints to the antennæ, whereas the adult has five. There are five stages in all, illustrated at *c*, *d*, *e*, *f*, and *g*. In the third and fourth nymphal stages the body is hemispherical and the resemblance to a turtle or terrapin is striking.

DISTRIBUTION.

The harlequin cabbage bug is a native of Mexico and Central America—where it obviously originated—and perhaps also of the semitropical regions in Texas, Arizona, and New Mexico. It was first

recorded in injurious numbers in Texas, in Washington County, in 1864,[a] and since then has traveled gradually northward, although not with uniform rapidity. Normally the species is probably tropical and has been diffused through two additional life zones, the Lower and Upper Austral. In the latter zone, however, it has not become permanently established much farther north than about the lower or warmer half. The region about Norfolk, Va., "the gateway of the South," is probably the northern limit of actual establishment in the East.

A year or two following its discovery as a pest this species had invaded Louisiana, and by 1867 was recorded from North Carolina. Its spread was most noticeable along the Atlantic seaboard and up the Mississippi River valley. In 1870 it had appeared in Missouri and Tennessee, and by 1876 had reached Delaware. In Maryland and Virginia, however, it did not attract attention until 1880. It was first recorded as injurious in New Jersey, at Woodbury, in 1892,[b] and in 1894 it was seen at Jamaica and "New Lots Road," New York.[c]

Westward we have office records of its occurrence in Colorado in 1882, at Pueblo and Denver, but it has never been an important pest in that region, and it was not until 1890 that it was recorded in Indiana and not till 1891 in Ohio. In the latter State it progressed steadily northward until it was checked by the same atmospheric conditions which prevailed in the Eastern States and which will be mentioned presently. In the Pacific region the species is well established in southern California, but there seems to be no published record of the time of its first appearance in that State. We received specimens from San Diego, Cal., as early as 1878. The insect is also recorded from Nevada.

The dispersion of this species in the Middle States has been traced by Mr. F. M. Webster,[d] and from what has just been stated and what has been placed on record by Messrs. Webster and Howard it is very evident that it has become diffused largely by what Doctor Howard terms "commercial jumps," as in the case of insects like the asparagus beetle. This is a matter quite simple of accomplishment, as fertile egg masses can be carried long distances on the insect's food plants—for example, on the outer leaves of cabbages—by railroads and by boat. It will be noted that after the establishment of the pest in Delaware it did not attract attention farther north until twenty years later; also, that other introductions were made in different directions quite independently of each other.

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[a] Recorded by Gideon Lincecum, Practical Entomologist, Vol. I, p. 110, Aug. 21, 1866.

[b] Lintner, 9th Rept. New York State Ent. f. 1892 (1893), pp. 315–317, 441.

[c] Sirrine, Bul. 83, New York Agl. Exp. Sta. (Geneva), Dec., 1894, p. 683.

[d] Proc. Ent. Soc. Wash., Vol. III, pp. 288–290, 1896.

To recapitulate: This species has obviously become diffused from a central point of dispersal, Mexico, chiefly in the following three directions: (1) From Texas eastward through the Gulf States and northward along the Atlantic seaboard to Long Island; (2) from Texas northward through the Mississippi Valley and thence through the Ohio River region into Ohio; (3) from Mexico into the neighboring States and Territories, and from Lower California into southern California and Nevada.

The northward migration of the harlequin bug, although not without interruption, was apparently quite steady until recent years. Beginning with the year 1897, at which time the insect had reached its maximum as a pest in Maryland, Virginia, Delaware, and adjoining States, climatic conditions adverse to its existence developed. These consisted of sudden changes of temperature, such as cold snaps followed by warm spells and the reverse during the winter. As a result this bug, with several other forms of southern origin, was killed while hibernating and practically disappeared in the North until, at the date of writing (1908), it is scarcely, if ever, reported as injurious from the District of Columbia northward. These conditions were particularly noticeable in the winter of 1898–99.[a] Small scattering colonies are, however, occasionally found in this region, chiefly on wild plants, late in the fall.

LIFE HISTORY.

In the warm and equable climate of the South where this species is at home it is more or less active throughout the year. Farther northward, however, after the first severe frosts of December it goes into hibernation in tufts of grass or under rubbish at the bases of cabbage stalks or in any convenient place. This takes place chiefly in the adult stage, although some nymphs of the last stages remain afield as late as November and December. Doubtless the nymphs succumb in time to cold, and hence fail to survive the winter.[b] The first warm days of February or March, in the Gulf region, or of April, farther north, see the bugs appear abroad and beginning to feed. At first wild mustard and other cruciferous weeds are attacked and soon the insects are ready to reproduce their kind. On these wild plants the eggs are deposited, on end, generally in two more or less

[a] See Bul. 22, n. s., Div. Ent., U. S. Dept. Agric., pp. 54, 55.

[b] A number of adults and nymphs in the last two stages obtained from Lambert's Point, Va., October 21, 1907, were placed in a rearing cage with growing cabbage plants, grass, and similar rubbish to provide means of hibernation. For over a month or until some time in December the insects continued feeding, but when examined during the first week of March it was found that all had succumbed to the severe cold weather of February.

parallel rows cemented together in groups of about a dozen, as shown in figure 1. They are normally placed on the under side of the leaves and hatch, in warm weather, in three or four days after deposition and in five to eight days in the cooler weather of early spring. The young bugs or nymphs pass through their five stages of metamorphosis with considerable rapidity. It has been stated that the life cycle could be completed in warm weather in about two weeks, but this is obviously an exaggeration, as it requires four or five weeks for the completion of the cycle in related insects.

The life periods of this species were unknown until worked out by Mr. H. O. Marsh, of this office. Specimens (from Texas) were under observation from the first week of March until the first week of May. They were under somewhat unnatural conditions, being confined in our office room, which was maintained during this period at an average temperature of from 68° to 70° F. The first or egg stage covered 11 days. The time from the hatching of the eggs until the first molt gave the first larval instar or nymph period 7 days; the second instar required 13 days; the third, 8 days; the fourth, 14 days, while the fifth or pupal instar covered 17 days—a total of 70 days, or 10 weeks, in all, which will be not far from the maximum active period of this species. The minimum will probably fall into much lower figures, probably half of this time, or at most not more than 42 days in extremely hot midsummer weather.

When cabbage and similar plants come up the insects migrate to them. It has been surmised that owing to the rapid development of the cabbage bug in the South there is a possibility of as many as seven or eight generations each year, while in the North three or more occur. The first supposition is doubtless overdrawn, as we know of no similar insect producing so many generations annually. This is a problem for future study. It seems probable that four or five generations would be a more natural limit in the South and two, or possibly three, in the North.

FOOD PLANTS.

In the autumn after the cabbage crop has been made and in early winter, even as far north as Washington, the bugs are still afield, seeming loath to seek shelter for the cold months. At this time they cluster on cabbage stalks and sprouts and the leaves of turnip and like plants, and when the supply of crucifers has become exhausted they will attack almost any form of succulent vegetation which is most available and palatable.

On one farm the writer observed a field of 10,000 cabbage plants completely ruined, which at the time of his visit, the first week in October, had been deserted by the bugs. An adjoining field of pota-

toes was then attacked, afterwards one of eggplant, and numerous bugs in various stages were observed sucking the juices of these plants. Unripe fruit of eggplant was especially relished, and ripe pods of okra and beans were also attacked.

The list of useful plants which this species has been found to damage includes all forms of crucifers or cole crops—cabbage and related plants, kale, collards and cauliflower, turnips, radish, horseradish, mustard, rape, and the like—and when these crops have been killed out truck crops of nearly all kinds are attacked, of which eggplant, asparagus, potatoes, tomatoes, okra, beans, and beets are most affected. Damage is sometimes done to ornamental plants such as roses, sunflowers, and chrysanthemums in flower gardens, and Mr. J. M. Rankin, while an agent of this Bureau at Chico, Cal., in October, 1905, reported that this species, after entirely destroying a half-acre plat of cabbage, attacked the other plants in the vicinity, including nursery plants of citrus, loquat, cherry and plum, squash, eggplant, "and in fact everything green." The fruit of grapes and late corn has also been attacked. The bugs are very partial to ragweed (Ambrosia), pigweed (Amarantus), wild lettuce (*Lactuca canadensis*), and lambsquarter (Chenopodium), congregating on all parts of these weeds but appearing to prefer the stems.

The wild food plants on which the species actually breeds include wild mustard and cresses of different kinds, shepherd's purse, peppergrass, bitter-cress, rock-cress, and practically all other plants of the mustard family (Cruciferæ) as well as some of the closely related caper family (Capparidaceæ).

NATURAL ENEMIES.

The comparative freedom from the attack of natural enemies which the harlequin cabbage bug enjoys is remarkable, and is due to two causes: First, to the warning type of its coloration—black and red or yellow; and, second, to its distasteful odor and flavor. This latter has been tested frequently. In the writer's experience birds that would attack most common insects would, when offered one of these bugs, either peck at it or look at it askance, or if by chance they ate a bug they did not repeat the dose.

Nevertheless the insect has one effective natural enemy, a minute parasite, *Trissolcus murgantiæ* Ashm., which develops in the egg. Prof. H. A. Morgan when in Louisiana discovered that out of over a thousand eggs under observation in 1902 nearly all were killed by this useful little creature. The eggs are also attacked by *Ooencyrtus johnsoni* How. and have been parasitized artificially by *Trissolcus podisi* Ashm.

This species is also preyed upon by another bug, *Arilus cristatus* L., the wheel bug, which the writer has frequently seen attacking the young harlequins.

The influence of natural elements, particularly cold winters, has already been mentioned as a means of decimating this pest. It is well to add, however, that the writer had this species under close observation in 1899, and that as a result of sudden cold snaps, 85 per cent of the bugs in fields near Washington in that year had been killed by January 15, 1900.

METHODS OF CONTROL.

The experience of years has shown that in order to obtain the best results in the treatment of the harlequin cabbage bug preventives are necessary, as there is great difficulty in obtaining insecticides which are effective and which do not at the same time injure or kill the plants. These preventives are: (1) Clean cultural methods, especially in the fall; (2) the use of trap crops of mustard or other plants in the spring, and (3) hand methods. With strict observance of clean farming few of the insects will survive the following spring and the adoption of trap crops leaves fewer still to be destroyed by mechanical measures. In some cases all three methods should be adopted, for if they are neglected the grower will find it a most vexatious matter to control the pest in the midst of the growing season.

Clean cultural methods.—Of prime importance are clean cultural methods. The value of clean methods of farming has been recognized by nearly everyone who has had experience with this insect. The practice of leaving stalks of cabbage and other cruciferous plants in the field late in the autumn and in the early winter, or of permitting rank weeds to grow up, or, in fact, allowing any sort of débris to accumulate, serves as a means of protracting the life of this insect, as all such material either affords it food late in the season or quarters for protection against the elements during winter. It is even inadvisable to plant crucifers in the vicinity of outhouses and barns, as the bugs are apt to enter these latter for passing the winter.

Throughout the year wild plants of the mustard family, on which the insect chiefly breeds, should be carefully kept down not only in the fields but in the immediate neighborhood. A list of such plants is given on page 6.

Trap crops.—Some plants, such as cabbage, turnip, or kale, may be planted late, to be left at intervals throughout infested fields. These trap plants attract the insects in the fall, and here the latter may be killed with pure kerosene, or by mechanical methods. Where it is convenient to leave piles of rubbish until the insects are attracted to them this may be done, and the entire material, insects and all, should then be burned.

The best remedy, however, and one that should be put into operation by every cabbage grower who is troubled by this pest, consists in planting an early crop, which may be either mustard, rape, or kale, as a lure for the first-appearing insects. Radish and turnip serve a similar purpose. In the Gulf States the overwintered adults appear in February and March, and in the District of Columbia and vicinity in the latter part of April. For some reason they appear to prefer the plants that have been enumerated, and wild mustard and other crucifers, for the first deposition of their eggs. On these crops and on weeds the insects can be killed with kerosene or by the hand torch or may be collected in nets, or they may be destroyed by burning the entire trap crop when this is of no special value. Numerous reports have been received at the Department of Agriculture, and others have been recorded, of the value of trap crops as a means of controlling this pest. Some of these are worth repeating.

The first test of the trap-crop remedy was made by Lincecum (l. c.) in Texas, in 1866. Noticing that the bugs were numerous on mustard and radish in April, he handpicked them and thus protected his cabbage crop. The practical utility of this method, however, does not appear to have been recognized until considerably later. In 1891, Mr. H. E. Weed, when entomologist of the Mississippi Agricultural Experiment Station, sowed a row of mustard through the center of a 1-acre field of cabbage. In April this mustard attracted the bugs in large numbers and on it they were killed with undiluted kerosene, with the result that throughout that season the field remained free from the pest, whereas the previous year the crop was almost entirely destroyed.[a]

Hand methods.—If determined efforts are made to stamp out the first generation fewer insects will remain to be dealt with and very

[a] A correspondent, Mr. J. H. Hevey, Ingomar, Miss., tested the trap-crop remedy, and wrote that when the bugs made their appearance on a bed of mustard he destroyed them by "bugging," i. e., by shaking them into pans of water on which a thin film of kerosene was floating. When the mustard was removed to make room for another crop a few cabbage plants became infested, but the bugs were killed as above, and finally, after the middle of July, none was left.

One of the largest growers of cabbage in Delaware reported (Sanderson, Bul. 26, n. s., Bur. Ent., U. S. Dept. Agric., p. 67, 1900) that at one time it was impossible to raise cabbage on account of this pest, but for several years he had used kale as a trap crop, and as a result of this procedure and careful handpicking of the few bugs that strayed to the cabbage, he had been troubled very little, while his neighbors' cabbage had frequently been ruined.

In April of one year in Maryland half an acre of kale became freely infested on one side by harlequin bugs. The insects had all congregated on this side. Under the writer's direction this portion was burned, straw being used to facilitate ignition. Two weeks later not a single bug could be found in a walk about this patch, and the cabbage which was growing in several plats in the vicinity was free from injury.

few will fly from other quarters for the continuation of the species. Thus injury may be greatly curtailed if not absolutely prevented for an entire season. The large size and bright colors of the insect render it easy of detection and its sluggish nature assists in its easy capture. Mr. H. Walter McWilliams, Griffin, Ga., reports that by offering a bounty to school children for the destruction of this pest he succeeded, in March and April, 1902, in destroying the first generation in that vicinity, and estimated that this experiment saved him $100 on his cabbage crop alone, not counting the benefit to the children.

As instance of the ease with which this insect may be hand-picked, a grower at Denton, Tex., gathered, in February of one year, 47,000 bugs. In case hand-picking has not been thoroughly done and some bugs have escaped this process and succeeded in depositing their eggs, the masses, which may be easily recognized by comparison with figure 1, *b*, should be carefully gathered and crushed.

Kerosene emulsion, according to the testimony of many who have experimented with it, is not effective against the adults and only partially effective when sprayed on the younger nymphs. Quite recently Prof. A. F. Conradi [a] has found that a 10-per-cent kerosene emulsion is effective in killing the nymphs, as is also whale-oil soap, at the rate of 2 pounds to 4 gallons of water. If the insects are sprayed just after they have molted these insecticides almost invariably kill them. It is obvious that further experimentation is desirable along this line.

Other remedies.—A few words should be said of other remedies and may be prefaced with the remark that since the harlequin cabbage bug feeds exclusively by *suction* and does not chew its food, the arsenicals, hellebore, and such remedies as are useful against cabbage worms are *absolutely valueless* against the present species. Pyrethrum is not effective and is, moreover, too costly. Hot water applied at a temperature of about 130° F. to the infested cabbage plants should be tested. It is not applicable, however, to large fields on account of the difficulty of maintaining the temperature at a given point, but may be found useful in kitchen gardens.

The value of hand torches for insecticidal purposes is extremely limited. The plumbers' torch is used considerably in Texas as a means of killing this insect, but growers are apt to expect too much of this method, and to apply it to too many kinds of insects, to the ultimate detriment of their crops.

It is possible that some of the natural enemies of this species, especially southern egg parasites, might be utilized in its control; i. e., by shipping parasitized eggs from localities where they are abundant to northern regions in which they do not occur.

[a] Bul. 89, Texas Agr. Exp. Sta., pp. 9–11, 1907.

SUMMARY.

The general account which has been given of this insect in preceding pages has been brought together at this time because of the practical certainty that in the natural course of events this bug will before long endeavor to reinvade territory north of its present range (in 1908), and may again become a pest for a number of years, until climatic conditions adverse to its development or increase check its northward spread.

In conclusion, it should be repeated that the systematic destruction of the insects by means of the trap-crop method described, together with a system of clean cultural practice throughout the entire season and especially in the late fall, will leave little else to be done save the gathering by hand of such insects as escape these measures or which may fly from infested to uninfested fields.

To prevent the pest from advancing farther northward than its present limits, careful watch should be kept for the first appearance of the insect, and remedies should be prompt and thorough. The importance of killing off the first or hibernated brood of bugs and their progeny can not be too strongly emphasized.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *May 4, 1908.*

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